THURSDAY, SEPTEMBER 20, 1917.

THE PUBLIC SCHOOLS AND NATIONAL SUPREMACY.

The Public-School System in relation to the Coming Conflict for National Supremacy. By V. Seymour Bryant. Pp. xviii + 78. (London: Longmans, Green, and Co., 1917.) Price 1*s.* 6*d.* net.

THE author has done useful service in writing this little volume. It contains a large amount of valuable information, while, of course, it raises a host of controversial points. His statement in the preface that "in the struggle for national supremacy education is the vital factor" will be disputed by few. It is when he comes to laying down the lines on which a reformed curriculum for both the preparatory and the public schools should be constructed that the whole of the forces of conservatism represented by the existing system will unite in a stubborn resistance.

A point Mr. Bryant makes early in the introduction consists in directing attention to the fact, familiar enough to those conversant with the educational world, though generally unappreciated by the public, that the headmasters of our great public schools are, practically without exception, classical scholars. Of the 114 schools represented in the Headmasters' Conference, ninety-two have classical headmasters, ten mathematical, seven jointly mathematical and scientific, four scientific, and one historical. And from the published numbers of boys in the schools 82 per cent. are under classical domination, while only 7½ per cent. are in schools where the head has any academic qualifications in science whatever.

This fact alone is sufficient to explain most of the difficulties encountered in all attempts to obtain more time and attention for natural science studies.

Every Englishman is proud to acknowledge the splendid spirit shown by all the public schools and their boys in connection with the war. It may be true that this is attributable to the conditions of life in the public schools, which favour the development of fine character. The amount of direct evidence for this conclusion is, however, very small, and it may be asked whether, after all, it is not something deep down in the English nature which is the real explanation of these things. Otherwise, how do we account for all the V.C.'s and other distinctions which rightly decorate so many of our brave fellows who have not had the advantage of a public-school education? The fact is sufficient that the boys from the public schools have made a fine show and have quitted themselves like men. But this does not abolish the other fact that the great majority of them when they leave school are very ignorant. How many can speak any language but their own? How many are really familiar with the great classics in their mother tongue? How many clergymen, whose office it is to search the Scriptures daily, are capable of studying the Gospels in the original Greek? Our Ministers and heads of Government departments have been almost to a man trained in the great public schools, but this has not saved them from the grossest kind of mistake in referring to common materials and processes of manufacture.

The public-school system of to-day, which is so largely due to Dr. Arnold at Rugby, owes all its best results to the principle of self-government by the boys themselves. The teaching in every subject and in every respect has improved since his time, but is still open to serious criticism. John Stuart Mill states somewhere that "the source of everything respectable in man is that his errors are corrigible," and that is all that can be said of the teaching in the public schools at this day. It is the prejudice of the headmasters and of the literary members of the staff which in most cases prevents that complete recasting of the time-table which alone will bring satisfaction to those who are interested in the use of scientific method and the sufficient teaching of natural and experimental science. Among other obstacles in the way of reform the author mentions examinations and the subordination of curricula to their requirements, the difficulty of obtaining properly qualified teachers, and the financial waste under the house system. With regard to the last point a great deal might be said. The fault lies primarily with the British parent, who is not willing to pay an adequate fee for his boy's education, but is ready to meet the charges of a comparatively expensive and unnecessarily luxurious kind of hotel. The true duties of a schoolmaster are so important that his pay and prospects ought to be both liberal and secure. But to give him a salary on which he cannot keep a wife and family in comfort and to allow him to compensate himself out of the profits of hotel-keeping is to adopt a system not far removed in principle from that of the Turkish Government, which pays no salaries, but allows extortion and pillage.

W. A. T.

USEFUL MATHEMATICS.

(1) *Commercial Arithmetic and Accounts.* By A. Risdon Palmer and J. Stephenson. Part i. Pp. xvi + 292 + lvi. (1908.) Part ii. Pp. xii + 293–514 + lvii–cliv. (n.d.) (London: G. Bell and Sons, Ltd.) Price 2*s.* 6*d.* each part.

(2) *Arithmetic for Engineers, including Simple Algebra, Mensuration, Logarithms, Graphs, and the Slide Rule.* By C. B. Clapham. Pp. xii + 436. (London: Chapman and Hall, Ltd., 1916.) Price 5*s.* 6*d.* net.

(3) *Practical Mathematics for Technical Students.* Part ii. By T. S. Usherwood and C. J. A. Trimble. Pp. x + 565. (London: Macmillan and Co., Ltd., 1916.) Price 7*s.* 6*d.* net.

(1) "THE present treatise on commercial arithmetic and accounts has been written to meet the needs of that great and ever-increasing army of students which is receiving a thorough commercial training in our modern

schools and colleges before entering upon a business career."

Such is the claim put forward by Messrs. Palmer and Stephenson in their preface. But there is a very large other class of pupil for whom it is growing daily more and more necessary to study books of this kind. We refer to the great army of students who do *not* receive a thorough commercial training in our modern schools and who do *not* contemplate entering upon a business career.

The game of keeping boys and girls shut up in stuffy rooms memorising things that will be of no use whatever to them in actual life, simply in order that they may score marks by copying them out in an examination-room, has been carried too far in the past, and we hope that one effect of the war will be to consign to the rubbish heap a large proportion of the waste luxuries of our present academic educational systems, and to replace them by subjects better calculated to develop national efficiency. A sound and thorough training in the principles of business and finance should not be the monopoly of a privileged class of pupils who enter special courses, but should be made available, and indeed compulsory, for every boy and girl who attends a secondary school, and may then go on to the university.

The present book contains exactly the kind of arithmetic which is required by everyone who hopes to earn money or to invest it and receive the interest, and who is compelled to pay rates and taxes. Everything is of the most practical nature possible. There are, in the two parts, sixteen facsimile illustrations of such things as cheques, stock and share certificates, poor-rate demands, receipts and the like, and the only thing wanted to make the collection complete is an income-tax form, which is what probably gives the average citizen more trouble than all the rest put together. But the subject-matter is by no means limited to questions of finance. Elementary mensuration is treated in great detail and applied to doors and windows, dust-bins, flower borders, bookcases, radiators, and other articles. Contracted multiplication and division are well done, although we regret that the authors do not explain how far the processes may be carried with approximate data. The authors also make every effort to introduce into the examples statistics relating to the trade and commerce of the British Empire. Moreover, the book is written in an interesting and stimulating style. Even at the very beginning we have a brief account of the methods of counting and numeration of early history and of savage tribes. It almost makes one wish one were a modern child, so that one could be educated on such a book instead of on the old useless drudgery of algebra and Latin and Greek genders.

When the book goes into a new edition we should ask the authors carefully to consider whether it would not be useful to introduce sections dealing with logarithms and the slide rules. There is unfortunately a widespread superstition among mathematical ignoramuses that it is necessary to repeat some nonsense about indices to every pupil before teaching him the simple rule that to multiply two numbers together you simply have to add their logarithms, but, judging from the present book, Messrs. Palmer and Stephenson appear quite capable of making the subject independent of this silly prejudice.

The insistence on rough checks in arithmetical work is very important, especially in view of the tendency among examination candidates to throw away 100 marks which they might have saved by checking one question in order to scrimmage five marks by starting another. The task of gathering together such enlightening collections of examples as are here found must have been very laborious, and we are surprised not to find Government examinations enumerated among the sources from which they are drawn.

(2) All science students, and, indeed, most other people, require some kind of training in the meaning, use, formulation, evaluation, and interpretation of algebraic formulæ, and their inverse uses involving the solution of equations. This is not the same thing as the addition, subtraction, multiplication, and division of the collections of dry bones hitherto described as "algebra," for the victims of that kind of drudgery often say they never knew these things had any use or meaning. A very fair introduction to what is required may be obtained by taking Mr. Clapham's "Arithmetic for Engineers" and turning to chaps. iii., iv., and v., which deal respectively with "Symbols and their Uses," "Simple Equations," and "Transposition of Formulæ." Here, then, is another instance in which class-distinctions require to be broken down, and the mathematical instruction drawn up for engineering students thrown open to the rank and file of the pupils of our schools and colleges. For nearly twenty years the writer of this review has persistently advocated that algebra should be taught through the *use of formulae,* such as area = length × breadth, the converse use or inversion of the formula leading to the problem of solution of equations, as when the area and breadth are given and the length is the unknown quantity. Although such a method is contemplated in a recent syllabus issued by the Civil Service Commission, Mr. Clapham is the first, or nearly the first, writer to develop this very simple and obvious method consistently. His method of treatment should even suffice to dispel the doubts which a beginner might experience as to the sanity of the mathematicians who use ab to denote the result of multiplying, instead of adding, a and b. Not only is the notation carefully explained, but multiplication and division formulæ take precedence, both in the text and examples, over those involving addition and subtraction, and the practical illustrations show that in dealing with concrete quantities brevity is often of more use in writing products than sums.

The two previous chapters deal with "Vulgar Fractions" and "Decimal Fractions" respectively. Here, again, we are glad to see insistence placed on *rough* checks and approximations, but at the same time the author, by his objection

(p. 50) to contracted methods, leaves the door open for the perpetration of unmathematical inaccuracies in the evaluation of results from approximate data. Thus, in the example on p. 50:—

$$\begin{array}{r} 1670 \\ 2{\cdot}75 \\ \hline 8350 \\ 11690 \\ 3340 \\ \hline 4592{\cdot}50 \end{array}$$

the final ·50 are wrong, because 0 and two blanks do not make 0, nor do 5 and 0 and one blank make 5. We do not know what these blanks are, and there is no justification for writing down ·50 as the result of addition of these incomplete columns. If we remember that 2·75 really may mean anything between 2·745 and 2·7549 it will readily be seen that the inaccuracies go further. Of course, if all the data are given and results required to three significant figures, the rule given on p. 50 is applicable, but a lot of superfluous figures will be written down and incorrectly added. Again, on p. 55 (Ex. 46: Divide 231·4 by 1·938) the author puts a lot of zeros at the end of the dividend and also carries down a lot of digits, although there are blank spaces requiring filling above them.

The rest of the book deals with logarithms, mensuration, the slide rule, and graphs. This is all useful and practical work, which may very well be taught to students other than engineers, perhaps with some reduction of the number of examples in mensuration. The majority of the "graphs" considered connect magnitudes of different kinds. Where this is not the case (as in equations of straight lines) we are glad to see that the author *does* represent the variables in their correct relative proportions, instead of perpetrating the distorted figures in which straight lines do not cut at the correct angle.

(3) For those who want the sort of thing that is contained in Part ii. of Messrs. Usherwood and Trimble's "Practical Mathematics," that book undoubtedly provides just the sort of thing they want. It is not the kind of book one altogether likes, and we could not recommend it to students of the academic type, except an occasional candidate reading for the B.Sc. degree in physics without taking mathematics as well. Undoubtedly vector analysis, advanced calculus and differential equations, Fourier's series, and inverted delta (∇) are required by engineering students, and if they can get all this and a little thermodynamics in a book of this size, they will not quarrel about rigorous demonstrations. The result is, however, a formidable mass of symbols and formulæ. Individually, we consider that the binomial, exponential, and hyperbolic functions should not be taught until after the elements of the calculus have been mastered; however, it is quite easy to begin at chap. vi. and take some of the earlier parts afterwards. The attempt to prove the differentiation formula for the sine savours too much of the "we see" or "we may put" of the typical narrow-minded mathematician. On the other hand, in dealing with symbolical notation, the authors make some effort to keep out of the pitfall into which Edwards plunged when he applied to inverse operations formulæ which he had proved only for direct ones. The introduction of thermodynamics in §51 enables the authors to teach some very important theorems in partial differentiation which the average academical student overlooks in his rush and hurry to satisfy the demands of the external examiner.

The examples are distinctly good, and this feature will undoubtedly appeal to teachers of pure as well as applied science.

At the end there is the usual collection of tables, with the usual superfluous duplication of logarithms and antilogarithms, squares and square roots, sines and cosines, and the usual shortcomings in the absence of tables of logarithms of reciprocals, and in the fact that the tables of squares do not give correct results when applied to the squares of integers. G. H. B.

OUR BOOKSHELF.

Steam Turbines. By J. A. Moyer. Third edition, revised and enlarged. Pp. xi+468. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 16*s.* 6*d.* net.

THIS book was first published in 1908; the additions made in the present edition have been mainly in the line of new applications. The book opens with some historical descriptions, followed by a brief section dealing with the elementary theory of heat, including explanations of entropy diagrams. The following chapters take up the design of nozzles and blades, and descriptions of commercial types of turbines.

The treatment of low-pressure, mixed pressure, bleeder, and marine turbines occupies separate chapters. Of these, the section dealing with the marine turbine is least satisfactory; the author's bias towards certain types is apparent here and elsewhere in the volume. Thus no mention is made of the Ljungström turbine, despite its importance, and in the marine section justice is not done to types of reduction gear other than the Westinghouse floating-frame type. Hydraulic transmission is not mentioned, and electrical transmission is dismissed in a few inadequate lines. There is a chapter on steam turbine economics giving information on cost of plant, maintenance and running; this information is of interest and is frequently omitted in British textbooks. Other chapters deal with stresses in rings, drums, etc., and include a few words on the critical speeds of loaded shafts. In describing testing arrangements, power is to be measured by Prony or water brake, or by electrical appliances; shaft-horse-power of marine turbines and its measurement by torsion-meter are not treated. Another chapter gives some information regarding the gas turbine, and might well have been omitted.